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Tortula aciphylla (B. & S.) Hartm. No. 264c, Tunnel Mt., 11-8-13.

Tortula ruraliformis (Besch.) Dixon, No. 12a, Buffalo Ave., Tunnel Mt., 10-13-13. No. 128, Aylmer Pass Flats, 9-20-16. No. 144a Simpson Pass Summit, 9-6-13. No. 262, Spray Ave. woods, 10-22-10.

Tortula ruralis (L.) Ehrh. No. 3, Buffalo Ave., 10-10-16. No. 7, no locality, 1910. No. 125, Sulphur Mt., 10-10-10. No. 180, Hot Springs, 6-20-04. No. 182, Sulphur Mt., 7-14-03. No. 197, across from C. P. R. Hotel, 6-27-0. No. 261, Spray Ave. woods, 10-22-10. No. 264a, Tunnel Mt., 11-8-13.

Ulota americana (Beauv.) Lindb. No. 12, Buffalo Ave., Tunnel Mt., 10-13-13. No. 250, Sulphur Mt., 9-9-13.

UNIVERSITY OF PITTSBURGH,
PITTSBURGH, PA.

HYMENOSTOMUM IN NORTH AMERICA

II. THE CASE OF ASTOMUM SULLIVANTII

A. LEROY ANDREWS

The first question that arises under the subgenus *Astomum* is manifestly whether or not *A. crispum* (Hedwig) Hampe of Europe occurs in America. It has generally been treated as a species of the three northern continents: Europe, Asia and North America. Attempts have at the same time been made to separate forms in all three continents, which however like many proposed new moss-species have served to obscure rather than clarify. The American species which have been subject to confusion with *A. crispum* are *A. Sullivantii* Bruch & Schimper and *A. nitidulum* Bruch & Schimper. The tendency has been growing of late to refer all North American specimens of this type to *A. Sullivantii*[1]. With this I find my own results entirely in agreement. The only supposedly North American specimen that I have seen that must apparently be referred to *A. crispum* is one now in the herbarium of the New York Botanical Garden, which, according to the label, came from the Mitten herbarium, where it was included in the cover of *Weisia convolutacea*[2]. It is further labeled as No. 46 of the Musci Bor. Amer. Exsicc. of Sullivant and Lesquereux (2nd ed.). This number is however, in the other sets which I have seen, not the same thing, but apparently *A. Sullivantii* as named. I assume then that there has at some stage been a mixing of labels and that the Mitten specimen is a European, probably an English one, it closely resembling other English specimens. Under the circumstances it is doubtless justifiable to exclude *A. crispum* as a

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[1] Even Georg Roth (Aussereuropäische Laubmoose, 1, 185. 1911), who did not aspire to be primarily a critic of species, suggested this relation, though figuring both *A. Sullivantii* and *A. nitidulum* separately.

[2] One of Mitten's species referable to *A. multicapsulare* according to Braithwaite.

North American species.[3] That the two continents should not exactly agree in this genus is not greatly to be wondered at. The *Dicranaceae*, in the broad sense of Brotherus, are largely boreal mosses with close circumpolar agreement of species. The *Pottiaceae* of Brotherus, in which he includes *Astomum*, are on the other hand very generally types of warmer latitudes and adapted to habitats with a hot, dry season. Agreement of species between Europe and North America is in this group not nearly so close. As to *Astomum* in particular, it does not in America extend north of the limits of the United States except in a single locality in the Saskatchewan region, where it has not been found since Drummond's day. It is a plant of open fields, not of forests or mountains. Furthermore according to the theory generally held at present with reference to cleistocarpous mosses they are for the most part, if not altogether, relatively young phylogenetic types, not replicts of early stages in bryologic evolution. This is obviously true of *Astomum* and explains in part why its species are in such a plastic state, so hard to grasp in their range of variation and to separate clearly from one another.

Hymenostomum Muhlenbergianum (Swartz) new combination. The earliest name for our common species is *Phascum Muhlenbergianum* Swartz. The name was published after Swartz' death (1818) in the "Adnotationes botanicae" edited by J. E. Wikström and published at Stockholm in 1829 (pp. 74f.). According to the preface (p. VI) Swartz received plants from Muhlenberg in 1810 and 1811. Muhlenberg in fact included the new name in his "Catalog" of 1813, but without accompanying description, though according to Swartz' preface the description had also been sent him. As to the type-specimen, I have on two different occasions gone through the Muhlenberg moss-herbarium at the Academy of Natural Sciences in Philadelphia. Thanks particularly to Mrs. Britton's work of revision the collection is in good shape for study. It contains a number of cleistocarpous mosses labeled *Phascum*, some of which are clearly referable to *Astomum*, but none is labeled *Phascum Muhlenbergianum* and it is perhaps a question whether Muhlenberg retained duplicates in the strict sense of specimens sent away for examination. His specimens are very meagre and accompanied by little or no data. Drummond, who saw his collection while on his second American collecting trip, calls them "miserable".[4] During the war years it was difficult for me to get information, to say nothing of specimens, from the Naturhistoriska Riksmuseum of Stockholm, where Swartz' herbarium now is. In the summer of 1919, however, Dr. Hjalmar Möller after a first unsuccessful search finally succeeded in finding the type-specimen of Swartz and kindly sent it to me. It is plainly marked *Phascum Muhlenbergianum* and corresponds otherwise closely with the description.

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[3] Grout (Mosses with Handlens and Microscope, 139. 1904) speaks also of a single specimen of *A. crispum* which he had seen from the northern States, with several from the southern ones. Apart from the improbability that our endemic species would be of more northerly distribution than the one common to Europe, I have been unable to identify any of our southern specimens with *A. crispum*, but have felt justified in referring them all to either *A. Sullivantii* or *A. ludovicianum*. It is possibly puzzling forms of the latter with abbreviated seta and general poor development that have suggested *A. crispum*, though such forms are not common. I would emphasize that apart from this minor point, I find myself in entire agreement with Grout and believe he had correctly grasped the essential facts with reference to our northeastern *Astomum*.

[4] Hooker, Journal of Botany, I, 54. 1834 (letter of Apr. 28, 1831).

Astomum Sullivantii Bruch & Schimper and *Astomum nitidulum* Bruch & Schimper were published in the *Astomum* monograph of Bryologia Europaea (XLIII, 2 and 3 respectively), whose date of publication according to the careful researches of Dr. Barnhart was 1850. Their descriptions are very brief and relegated in fine print to the foot-notes and no exact locality is given, but *A. nitidulum* is characterized as growing with *A. Sullivantii.* Under the circumstances it is but natural that bryologists have had difficulties in interpreting the types. C. Müller, for example, in 1851[5] supposed that both were to be found in No. 211 of Sullivant's Musc. Allegh., which was collected in Virginia in 1843 and distributed (as *Phascum crispum*) in 1845. Mrs. Britton has however in her (unpublished) studies on *Astomum* identified as the type of *A. Sullivantii* a specimen collected by Sullivant in Ohio in 1842 labeled *Phascum crispum* and numbered 116. A drawing in the herbarium of the New York Botanical Garden executed by C. H. Wright, Oct. 21, 1890, from the Schimper herbarium at Kew represents this in fact as the type. Sullivant in his Musci and Hepaticae of the United States (1856, p. 16) mentions *Phascum nitidulum* as occuring only in central Ohio, which would tend to confirm the idea that the type of both specimens was from Ohio. Wright's drawing of *A. nitidulum* from the Schimper herbarium is on the other hand taken from a specimen collected by James at Easton, Pennsylvania, in 1868, which is of course not the type, and it would appear from the original statement in Bryologia Europaea that this species was really based upon some aberrant plant growing with the type-specimen of *A. Sullivantii.* The specimen in Sullivant & Lesquereux, Musc. Bor. Amer. Exsicc., No. 36 (also 2nd ed., No. 47) as *A. nitidulum* (locality not given) might have some value as representing Sullivant's idea of what the species was, and it has been the working basis for the separation of this species by North American bryologists. It does not however show two characters ascribed to the original, both in the Bryologia Europaea and by Sullivant, viz., the rather long seta and the differentiated line of operculation, but is a small form with more deeply pigmented capsule, which appears to fall entirely within the limits of variation of *A. Sullivantii,* as do nearly all specimens since called *A. nitidulum.*

The late Prof. L. W. Riddle shortly before his death looked very carefully through the Sullivant herbarium with reference to the type of this species, as well as of *A. Sullivantii,* and found that a small specimen of *A. nitidulum* had been sent to Sullivant by Schimper, but had fallen from the bit of paper in which it was enclosed and is irretrievably lost. Sullivant's note reads: "Schimper in letter dated April 1850 says in specimens I sent him marked 'No. 116, Ohio,

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[5] Synopsis, II, 519.

1842, *Phascum crispum*' there are two new species which he names *Astomum Sullivantii* and *Astomum nitidulum*—he gives no characters—but sent small specimens of each—one of them I lost in opening the paper." An empty packet in the Sullivant herbarium labeled "*Astomum nitidulum* W. P. Schimp. (*Ast. Sullivantii* immixtum Sulliv. misit) W. S. S. Ohio 1842" commemorates the loss. Mr. H. N. Dixon has also been so kind as to go through the Schimper herbarium at Kew with reference to this matter and finds no type-specimen of *A. nitidulum* preserved as such and no other species mixed with the type-specimen of *A. Sullivantii.* He sends me however copies of drawings found in the packet of the type of *A. Sullivantii,* which, though not labeled, apparently represent the lost *A. nitidulum.* Later specimens labeled *A. nitidulum* he thinks are not specifically separate from *A. Sullivantii.* The type of *A. nitidulum* was then apparently the bit sent to Sullivant, which is lost. It is possible from the brief original description that it contained a somewhat variant capsule of *A. Sullivantii,* but I think much more likely it was a hybrid capsule of *Weisia viridula* upon *A. Sullivantii.* There is in the Sullivant herbarium a small specimen of later collection labeled "Verum *Phascum nitidulum* Sch. Columbus Ohio 1855." I have seen a single plant of this through the kindness of Prof. Thaxter and have no doubt that it does agree with the original type, as it does in fact with the original description. My conclusion then is that *A. nitidulum* of the S. & L. exsiccati and generally subsequently is synonymous with *A. Sullivantii,* that is with *Hymenostomum Muhlenbergianum,* but that Schimper was probably justified in his original distinction and that his *A. nitidulum* was presumably of hybrid origin. The whole question of hybrids in this genus I hope to discuss at greater length subsequently.

The differences between the European and the American species are quantitative in their nature, as is likely to be the case with closely related cleistocarpous mosses, the American one tending to be smaller in its parts except the spores, which are consistently larger and furnish perhaps the clearest and most tangible diagnostic character. The relation of diameters is as I find it at least 6 to 5, in *A. Sullivantii* about 20μ (running up to 25μ or more), in *A. crispum* about 17μ. Doubtless abnormal specimens may be found somewhat bridging over the gap, but the tendency of the American form to produce larger spores is beyond dispute. The larger size of spores marks under the circumstances a species farther down in the scale of organization, a more cleistocarpous moss. With this the other characters are in accord. The generally smaller size of the American species is also shared by the capsule, which futhermore has thinner walls, more easily dented out of shape or for that matter broken open, letting the light through more readily,[6] showing rather larger exothecial cells,[7] more pigmented orange to purplish, as contrasted with the normal brown of *A. crispum.* The operculum of *A. Sullivantii* is never separated off, while that of *A. crispum,* though varying somewhat in this respect, tends to be well marked off, or even in extreme cases separable. These differential characters are perhaps not wholly convincing, but as they seem to fairly consistently separate the plants of two rather remote areas they may, I think, be safely regarded as justifying the treatment of the American plant as a distinct species, though I have no especial quarrel with anyone preferring to call them marked geographical varieties of a single species. Characters of the gametophyte in these plants are elusive, not to say illusive, and appear to add nothing in this case, except the generally somewhat coarser manner of growth of the European species. The American species is by no means without variation and in fact runs through a series of forms that are often parallel to those European ones which have been treated as independent species. Mrs. Britton had for example in her earlier study of the genus segregated a number of specimens from our northeastern states, which she called *Astomum multicapsulare* (Sm.) Br. & Sch.[8] This form is distinguished by an elongated stem, even up to an inch or more in height and

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[6] The remarkable difference in this respect shows itself clearly in cross-section of the capsules, the European species showing a wall 8–10μ or even more in thickness, with several layers of fairly strong cells between it and the spore-sac, and a stronger columella, while the American species is only sectioned with difficulty owing to its extremely thin wall (hardly more than 1–2μ) and the

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collapse of the weak cells between it and the spore-sac, a single layer of thin cells usually appearing in section. This character however like others is not an absolute one, as occasional American specimens show a somewhat thicker wall, but is not without significance in the aggregate of features. It is perhaps of passing interest to note that the type of *A. Levieri* Limpricht of southern Europe, a bit of which I owe to the kindness of the late Georg Roth, shows a very thin capsule-wall, as in fact noted by Limpricht in his original description (Rabenhorst,Kryptogamenflora, IV, iii, 638. 1901), though the plant shows otherwise no close relation to our species.

[7] The individual cells vary so much in size and shape that it is not easy to establish a basis of comparison, but it is certainly true that with a decidely smaller capsule the North American species has slightly larger, or at least broader, exothecial cells than the European. The striking impression is that of the small number of exothecial cells to the capsule in the American species. The European shows a greater tendency to have the exothecial cells longer than wide, that is, lengthened in the longitudinal direction of the capsule, another mark of the less cleistocarpous, more advanced species.

[8] It is not my intention to express any opinion on European species, except as is rendered necessary by the interpretation of our own forms, but I would call attention to the fact that the name of *A. multicapsulare* is not wholly satisfactorily founded. It has been noted that it does not especially apply, as it generally bears but a single capsule (Dixon, Student's Handbook of British Mosses, 206. 1896; Bruch & Schimper, Bryologia Europaea, Monograph *Astomum,* 4. 1850). Smith's *Phascum multicapsulare* (Flora Brittanica, 1152. 1804) is based on specimens collected by Chas. Abbot and cites the latter's *P. sphaerocarpon* (Flora Bedfordiensis, 230.1798) as a synonym, also the *P. crispum* of Swartz' Musc. Suec., 17 and the plate No. 618 in English Botany. This plate (Smith, English Botany, IX. 1799) is from Bedfordshire specimens discovered in March, 1799 by Abbot. The plate is labeled *P. crispum* and appears to me to represent that species, though I may be in error. Anyhow, if *P. multicapsulare* is not *P. crispum* or a mixture, it is only a later synonym of *P. sphaerocarpon,* which should as the prior name be restored. According to Smith, Abbot collected *P. crispum* as well as *P. multicapsulare* near Bedford.

I note also an *Astomum intermedium* Péterfi, which appears to have found no place in European bibliography. It is referred to by its author in a reprint from the Mathematische und naturwissenschaftliche Berichte aus Ungarn, XIX, 356, which appears to be a German translation from the Potfüzetek a Természettudományi Közlönyhöz, LXI, 143, Budapest, 1901, the original publication of the species being in LII, 108 of this latter series.

grows, according to observations of Austin, in wet places. In a series of specimens it seems to connect through all degrees with the normal *H. Muhlenbergianum* and to be unworthy of taxonomic distinction, except as one wishes to admit to taxonomic distinction forms due directly to difference of habitat. In fact Muhlenberg's original specimen, probably collected about Lancaster, Pennsylvania, tended somewhat toward this type, it being described as up to half an inch in height, but really falling somewhat short of that. Another variation also represented by the original specimen and noted in its description is a slight lengthening of the seta. This is, however, very slight, so that the combined seta and vaginule do not surpass in length the capsule itself, being just about equal to it in the Muhlenberg specimen. I cannot see that this character is more than a casual variation and it is correlated with nothing else, unless it be that it is more likely to occur in specimens showing a somewhat, but not extremely lengthened stem.

H. Muhlenbergianum is a fairly widely distributed species, its northwestern outpost being the Saskatchewan where it was collected by Drummond in 1827, its southwestern, southern Arizona, where it was found by Leiberg in 1906, its northeastern, Massachusetts[9], and its southeastern North Carolina, though it extends further south in Louisiana and Texas. Within this area it may be looked for almost anywhere in fields, though the finding of it is not an everyday affair. It may yet be found to pass these limits in places, but they probably pretty well indicate its total range. It evidently does not reach west of the Rocky Mountains.

Specimens of *Astomum* from China and Japan I have not had opportunity to study in adequate detail or sufficient number to reach any positive results. It seems to me worthy of careful investigation whether *A. crispum* occurs in Asia at all and whether the (or a) species which does occur may not be more closely related to our own *Hymenostomum Muhlenbergianum*. In the Cornell University Herbarium is a specimen of hepatic labeled "*Grimaldia fragrans* Corda. Tokyo, 1897", without further data as to collector, etc., which has many plants of *Astomum* growing with it. These show a small deeply pigmented capsule with the thin wall characteristic of *H. Muhlenbergianum*, while the spores when ripened average also fully 20μ. The gametophyte is even smaller than is generally the case with our species. A specimen from the Jaeger herbarium labeled "*Phascum crispum*, Japonia" is quite similar.

ITHACA, N. Y.

NOTE—DATA WANTED

Will the member who sent me by mail a box of fresh *Asterella* some two months ago, kindly write me? No letter or other data came with the specimen, which has proved to be of interest.

GEO. H. CONKLIN,
201–202, Board of Trade
Superior, Wisc.

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[9] It has been found in New York state as far north as Fort Edward.